
Revitalizing the Space Shuttle's Thermal Protection System with Reverse Engineering and 3D Vision Technology

Brad Wilson United Space Alliance LCC

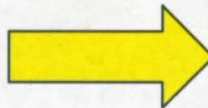
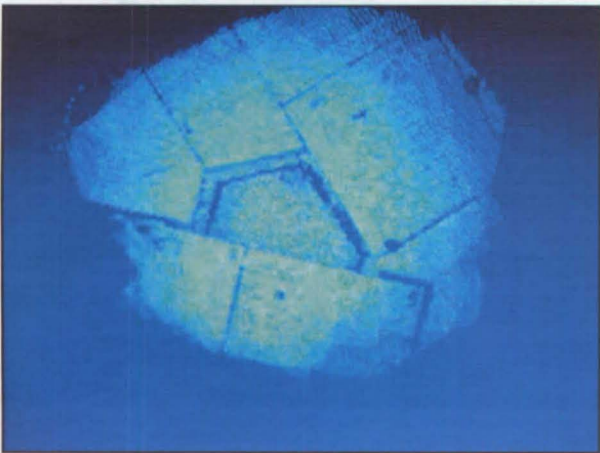
Yishai Galatzer, Cognitens, Inc.

Date 7-21-2008

Revitalizing the Space Shuttle's Thermal Protection System with Reverse Engineering and 3D Vision Technology

- **Abstract:**
- The Space Shuttle is protected by a Thermal Protection System (TPS) made of tens of thousands of individually shaped heat protection tile. With every flight, tiles are damaged on take-off and return to earth. After each mission, the heat tiles must be fixed or replaced depending on the level of damage. As part of the return to flight mission, the TPS requirements are more stringent, leading to a significant increase in heat tile replacements.
- The replacement operation requires scanning tile cavities, and in some cases the actual tiles. The 3D scan data is used to reverse engineer each tile into a precise CAD model, which in turn, is exported to a CAM system for the manufacture of the heat protection tile. Scanning is performed while other activities are going on in the shuttle processing facility. Many technicians work simultaneously on the space shuttle structure, which results in structural movements and vibrations.
- This paper will cover a portable, ultra-fast data acquisition approach used to scan surfaces in this unstable environment. The presentation will discuss the entire process used to produce a quality tile in a fraction of the time and cost of older techniques. After proven successful on the STS-114 mission, the 3D Vision scanning procedure is now used for all three shuttle processing facilities.

Revitalizing the Space Shuttle's Thermal Protection System with Reverse Engineering and 3D Vision Technology



REPORT DOCUMENTATION PAGE					Form Approved OMB No. 0704-0188	
The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.						
1. REPORT DATE (DD-MM-YYYY) 21-07-2008		2. REPORT TYPE Technical		3. DATES COVERED (From - To) June 2003- Oct-2005		
4. TITLE AND SUBTITLE Revitalizing the Space Shuttle's Thermal Protection System with Reverse Engineering and 3D Vision Technology				5a. CONTRACT NUMBER NNJ06VA01C		
				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER		
				5d. PROJECT NUMBER		
6. AUTHOR(S) Brad Wilson TPS Engineering United Space Alliance Yishai Galatzer Cognitens, Inc.				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Brad Wilson TPS Engineering United Space Alliance 8600 Astronaut Blvd Cape Canaveral Fl. 32920 Yishai Galatzer Cognitens, Inc. 51170 Grand River Ave. Wixom, MI, 48393				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) CMSC Society 2519 152nd Avenue NE Redmond, Wa. 98052 Contact: Rina Molari-Korgel 1404 Timberline Drive Benbrook, TX 76126 817-683-2261				10. SPONSORING/MONITOR'S ACRONYM(S) (CMSC) Coordinate Metrology Systems Conference		
				11. SPONSORING/MONITORING REPORT NUMBER		
12. DISTRIBUTION/AVAILABILITY STATEMENT Copyright © 2008 by United Space Alliance, LLC. These materials are sponsored by the National Aeronautics and Space Administration under Contract NNJ06VA01C.						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT The Space Shuttle is protected by a Thermal Protection System (TPS) made of tens of thousands of individually shaped heat protection tile. With every flight, tiles are damaged on take-off and return to earth. After each mission, the heat tiles must be fixed or replaced depending on the level of damage. As part of the return to flight mission, the TPS requirements are more stringent, leading to a significant increase in heat tile replacements. The replacement operation requires scanning tile cavities, and in some cases the actual tiles. The 3D scan data is used to reverse engineer each tile into a precise CAD model, which in turn, is exported to a CAM system for the manufacture of the heat protection tile. Scanning is performed while other activities are going on in the shuttle processing facility. Many technicians work simultaneously on the space shuttle structure, which results in structural movements and vibrations. This paper will cover a portable, ultra-fast data acquisition approach used to scan surfaces in this unstable environment.						
15. SUBJECT TERMS Computer-aided manufacturing (CAM) Computer-Aided Design (CAD) Thermal Protection System (TPS)						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NUMBER OF PAGES 20	19a. NAME OF RESPONSIBLE PERSON Bradley R Wilson	
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include area code) (321) 861-0523	